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Original research

Single center outcomes of laparoscopic transperitoneal lateral adrenalectomy – Lessons learned after 500 cases: A retrospective cohort study

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HIGHLIGHTS

- The outcomes of laparoscopic transperitoneal lateral adrenalectomy depend on the volume of the department.
- Gaining the experience with laparoscopic adrenalectomy reduces complication rate and shortens length of hospital stay.
- Involving surgery residents in training is associated with longer operative time but with no impact on clinical outcomes.

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ABSTRACT

Introduction: Although laparoscopic adrenalectomy is considered relatively safe, the results of treatment vary depending on the profile of the hospital. We would like to present our experience with laparoscopic surgery of the adrenals.

Methods: We conducted a retrospective cohort study of consecutive patients operated for adrenal tumours in the years 2003–2014. The study group included 175 (35%) men and 325 (65%) women. The entire group was divided into 4 cohorts of 125 consecutively operated patients. Primary outcomes were operative measures (operative time, its correlation with tumour size, blood loss, conversion rate, use of peritoneal drainage). Secondary outcomes were the intra- and postoperative complications (using the Clavien-Dindo classification), histological type of the tumours and length of hospital stay.

Results: There were no differences between groups in terms of the size and location of the tumour. The mean operative time in each group was 85.7; 83.7; 89.6; 104.6 min ($p < 0.001$). The operative time correlated to the size of the tumour. There were no differences in the conversion rates as well as in the blood loss. However, it was observed that the complication rate was declining in subsequent subgroups (14.4%, 11.2%, 8% and 5.6%, respectively, $p = 0.013$). Length of hospital stay was 4.9 days, 3.9 days, 2.9 days, 2.4 days, respectively ($p < 0.001$).

Conclusion: The results of laparoscopic adrenalectomy depend not only on the experience of the single surgeon, but on the whole team involved in perioperative care. In high volume centers with extensive experience in surgery of adrenals, this technique may provide an alternative to open surgery, also in selected cases of malignant tumours.

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1. Introduction

The first laparoscopic adrenalectomy was described in 1992 by Michel Gagner [1]. As it soon turned out, the new surgical access implies a number of advantages: early recovery, lower complication rate, reduced postoperative pain, better cosmetic effect, and improved access to the operated area [2,3]. In the initial stage of its introduction, laparoscopy was only used to remove small adenomas, but the indications gradually extended to bigger lesions; therefore, it has quickly become the gold standard for the treatment of all benign adrenal tumours [3–6]. Improving the quality of imaging and the popularity of laparoscopy resulted in the constantly growing number of laparoscopic adrenalectomies performed worldwide [7]. In the 1990s, most of high-volume laparoscopic adrenal units developed either from pre-existing endocrine surgery or urology departments, in which laparoscopic surgery has not yet been performed or, alternatively, laparoscopic units extended their field of interest into minimally invasive adrenal surgery. Although this procedure is considered relatively safe, the presented treatment results vary depending on the hospital's profile [4], and may be affected by such factors, as a surgeon's experience in the treatment of patients with adrenal pathology, as well as the number of adrenalectomies performed annually. We would like to present our experience with developing a high-volume laparoscopic adrenal centre on the basis of a well-established minimally invasive surgery department, over the last 11 years.

2. Methods

Our department is a part of a tertiary referral university hospital. A retrospective cohort study, using a prospectively collected database, included consecutive patients operated for adrenal tumours in the years 2003–2014. The indication for surgery was either a hormonally active tumour, or, in the case of non-secreting incidentaloma, size ≥40 mm, rapid growth in follow-up studies, or a so-called radiological malignant phenotype of the tumour. Additionally, the study included patients operated for isolated metastases, as well as those with suspected primary adrenal malignancy, submitted to minimally invasive surgery. Patients under the age of 18 or undergoing open adrenalectomy were excluded from the study. All patients underwent preoperative imaging studies (ultrasound, computed tomography (CT), magnetic resonance imaging (MRI), or, if necessary, positron emission computed tomography (PET). Prior to surgery, a routine panel of laboratory tests was carried out to establish the hormonal activity of the tumour. The evaluation included plasma cortisol, urinary free cortisol, ACTH, DHEAS, 17-OH-progesterone, testosterone, plasma renin activity, as well as aldosterone, urinary aldosterone, catecholamines and vanillylmandelic acid excretion. In cases of suspected pheochromocytoma, patients were preoperatively treated with alpha-blockers (doxazosin 20 mg/day, additional beta-blockers in case of co-existing tachycardia) and intravenous volume expansion with crystalloids (2000 ml/day starting on the day before surgery). The operative method of choice in our department is laparoscopic transperitoneal lateral total adrenalectomy, which is performed similarly to described elsewhere [1]. In cases of bilateral disease, staged adrenalectomy was performed. The policy of our unit is to always begin with laparoscopy (also in cases of highly suspected cancer) and convert when safe and radical dissection is impossible. During the study period, there was only one patient with 24 cm tumour, who was initially submitted to open adrenalectomy. We attempted the laparoscopic procedure in all remaining cases. For the purpose of further analysis, the entire study population was grouped into 4 cohorts of 125 consecutively operated patients. All patients in group 1 were operated by the same experienced laparoscopic surgeon. Starting from group 2, procedures were performed by other general surgery specialists (in the learning curve of laparoscopic adrenalectomy) under his supervision, whereas most patients in group 3 were operated without supervision. Finally, supervised senior residents in training operated most patients from group 4. Primary outcomes were operative measures (operative time, its correlation with tumour size, blood loss, conversion rate, use of peritoneal drainage). Operative time was measured from skin incision to closure; tumour size was estimated in imaging studies (CT/MRI). The intraoperative blood loss was measured from the amount of blood aspirated in the suction machine. Secondary outcomes were the intra- and postoperative complications (using the Clavien-Dindo classification), histological type of the tumours removed and the length of hospital stay [8].

Statistical analysis was performed using the Statsoft Statistica v. 10. Elements of descriptive statistics were used (mean, standard deviation, percentage distribution). The analysis used the Cochran Armitage trend test, Kruskal–Wallis test, Chi-square test and the Pearson's correlation coefficient. Results were considered statistically significant when p-value was found to be less than 0.05.

3. Material

The study group included 175 (35%) men and 325 (65%) women. The mean age was 54.9 years (18–87 years, SD ± 13.8 years). The mean size of the removed lesion was 37.6 mm (7–160 mm, SD ± 19.7 mm). The indication for surgery was a hormonally inactive tumour in 198 (39.6%) patients, a catecholamine-secreting tumour in 137 (27.4%) patients, a glucocorticosteroid-secreting tumour in 77 (15.4%) patients, an aldosterone-producing tumour in 59 (11.8%) patients, a virilizing tumour in 6 (1.2%) patients, and metastasis to the adrenal gland in 23 (4.6%) patients (Table 1). The annual number of adrenalectomies performed in the following years is shown in Graph 1.

4. Results

The demographics of the analysed subgroups are shown in Table 2.

The obtained data showed statistically significant differences in the mean age ($p = 0.007$). Additionally, there were no statistical differences between groups in terms of the sex, size and location of the tumour (right/left side).

The mean operative time in each group was 85.7; 83.7; 89.6; 104.6 min, respectively. We noticed a statistically significant difference between the groups - the shortest operative time was observed in group 2, and the longest in group 4 ($p < 0.001$, Fig. 1).

It was observed that the operative time correlated to the size of the tumour ($p < 0.001$, Fig. 2).

Conversion was necessary in a total of 7 patients (3 patients in group 1 and two in the groups 2 and 3 each. The reasons for conversion are presented in Table 3.

The differences in the conversion rates were not statistically significant ($p = 0.431$). The mean blood loss in the whole study

Table 1
Hormonal activity of the tumour.

Nonfunctioning adrenal tumour	198 (39.6%)
Catecholamine-secreting tumour	137 (27.4%)
Glucocorticosteroid-secreting tumour	77 (15.4%)
Aldosterone-secreting tumour	59 (11.8%)
Adrenal metastasis	23 (4.6%)
Virilizing tumour	6 (1.2%)

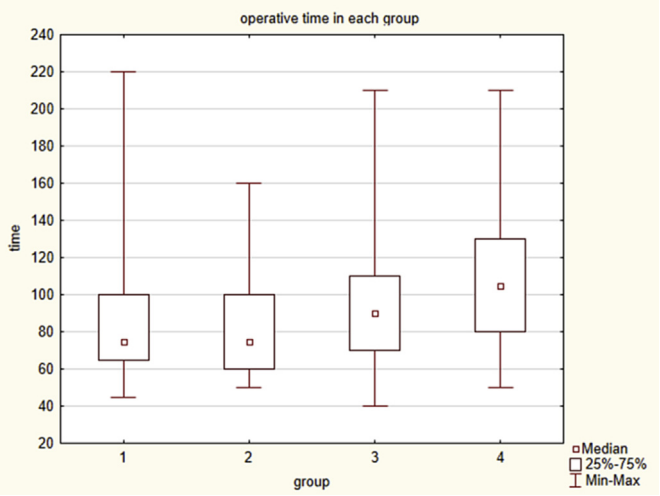


Fig. 1. Mean operative times in subsequent groups.

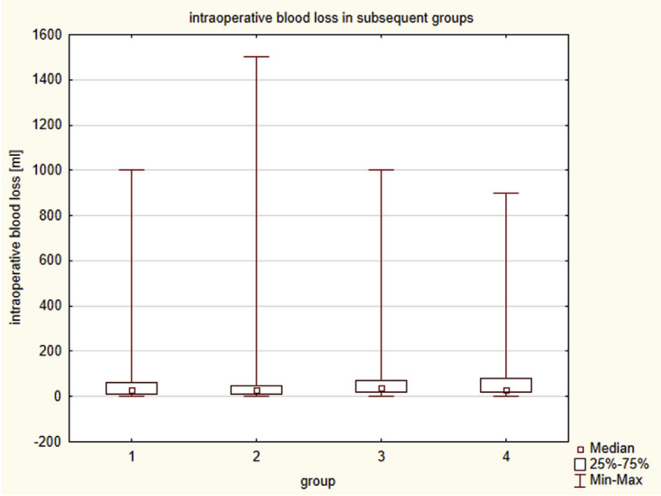


Fig. 3. Mean intraoperative blood loss in subsequent groups.

group was 74 ml (10–1500 ml) and there were no statistically significant differences between the groups ($p = 0.241$, Fig. 3).

A total of 11 (2.2%) patients required blood transfusions. A summary of results is presented in Table 4.

It was observed, however, that the complication rate was declining in subsequent groups (14.4%, 11.2%, 8% and 5.6%, respectively). Statistical differences between groups were observed ($p = 0.013$). A detailed analysis of the types and rates of complications is shown in Tables 5 and 6. Readmission within 30 day after surgery was necessary in 2 patients – one from group 2 (pulmonary embolism) and the other from group 3 (pneumonia, $p = 0.205$).

Relaparoscopy due to postoperative bleeding was necessary in two cases. One death was reported in the study group – a patient with pheochromocytoma (ASA grade 4) died seven days after surgery due to cardiopulmonary failure. When analysing the use of peritoneal drainage, it was established that in group 1 it was used routinely in all patients. In later periods this frequency decreased, amounting to 85.6%, 24%, 3.2%, respectively ($p < 0.001$). The length of hospital stay varied significantly, depending on the period in which the surgery was performed. In group 1, it was 4.9 days, in group 2–3.9 days, in group 3–2.9 days and in group 4–2.4 days ($p < 0.001$).

The most common histological type of lesions removed was adenoma - 187 (37,4%) patients, and nodular hyperplasia - 103 (20,3%) patients. In 98 (19.6%) cases postoperative pathologic evaluation confirmed the diagnosis of pheochromocytoma, of which 16 (11.2%) had the PASS score (Pheochromocytoma of Adrenal Gland Scaled Score) equal to or greater than 6. 23 (4.6%)

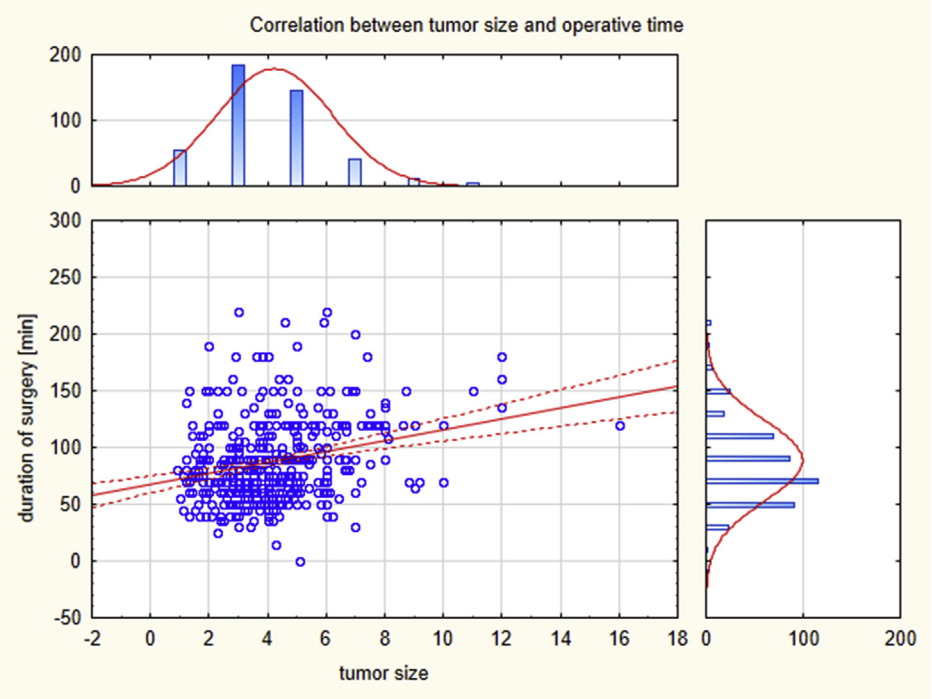
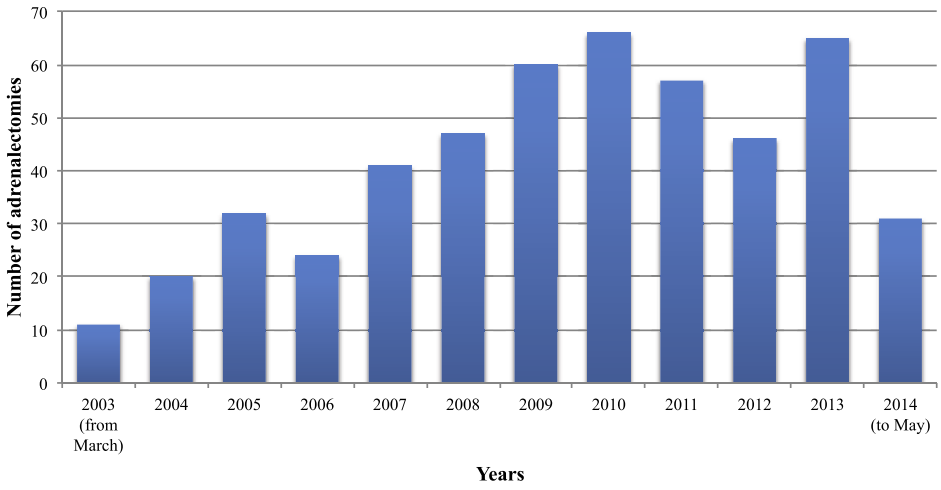


Fig. 2. Correlation of the tumour size and the operative time (Pearson correlation).



Graph 1. The annual number of adrenalectomies performed in the following years.

Table 2
Demographics of the analysed groups.

	Group 1 (patients 1–125)	Group 2 (patients 126–250)	Group 3 (patients 251–375)	Group 4 (patients 376–500)	p value
Age (years)	51.6 (SD ± 15.4)	54.5 (SD ± 11.2)	55.3 (SD ± 14.0)	58.1 (SD ± 13.6)	0.007[a]
Sex distribution					
Women	84 (67.2%)	93 (74.4%)	67 (53.6%)	81 (64.8%)	0.142[b]
Men	41 (32.8%)	32 (25.6%)	58 (46.4%)	44 (35.2%)	
ASA (American Society of Anaesthesiologists) grade					
ASA 1	15 (12.0%)	7 (5.6%)	10 (8.0%)	13 (9.6%)	0.638[b]
ASA 2	68 (54.4%)	80 (64.0%)	70 (56.0%)	71 (56.8%)	
ASA 3	37 (29.6%)	36 (28.8%)	42 (33.6%)	39 (31.2%)	
ASA 4	5 (4.0%)	2 (1.6%)	3 (2.4%)	2 (1.6%)	
Side					
Right	61 (48.8%)	58 (46.4%)	62 (49.6%)	60 (48%)	0.968[b]
Left	64 (51.2%)	67 (53.6%)	63 (50.4%)	65 (52%)	
Tumour size (mm)	38.9 (SD ± 18.1)	39.1 (SD ± 21.8)	32.7 (SD ± 18.3)	39.5 (SD ± 20.0)	0.520[a]
Benign/malignant	118 (94.4%)/7 (5.6%)	113 (90.4%)/12 (9.6%)	118 (94.4%)/7 (5.6%)	115 (92.0%)/10 (8.0%)	0.540[b]
Functioning/non-functioning	78 (62.4%)/47 (37.6%)	75 (60.0%)/50 (40.0%)	68 (54.4%)/57 (45.6%)	81 (64.8%)/44 (35.2%)	0.374[b]

[a] Kruskall-Wallis analysis of variance.
[b] Chi-square test.

Table 3
Reasons for conversion.

	Definitive diagnosis	Size	Reason for conversion
1.	Pheochromocytoma	67 mm	hemodynamic instability, abnormal location of the tumour
2.	Metastasis (Non-small cell lung cancer)	80 mm	infiltration to adjacent organs
3.	Pheochromocytoma	50 mm	infiltration of the abdominal wall
4.	Adrenocortical cancer	160 mm	damage of the tumour capsule
5.	Metastasis (Renal cell cancer)	88 mm	adhesions after previous surgery
6.	Adrenocortical cancer	120 mm	adhesions after previous surgery
7.	Pheochromocytoma	120 mm	uncontrolled bleeding

Table 4
Results of surgery in subsequent groups.

	Group 1 (patients 1–125)	Group 2 (patients 126–250)	Group 3 (patients 251–375)	Group 4 (patients 376–500)	p Value
Operative time (min.)	85.7 (SD ± 37.0)	83.7 (SD ± 29.7)	89.6 (SD ± 29.8)	104.6 (SD ± 34.9)	<0.001[a]
Intraoperative blood loss (ml)	64.8 (SD ± 117.9)	68.3 (SD ± 153.0)	74.6 (SD ± 129.8)	84.3 (SD ± 151.4)	0.241[a]
Post-operative drainage	125 (100%)	107 (85.6%)	30 (24%)	4 (3.2%)	<0.001[b]
Conversion	3 (2.4%)	2 (1.6%)	2 (1.6%)	0 (0%)	0.126[b]
Reoperation	1 (0.8%)	1 (0.8%)	0 (0%)	0 (0%)	0.205[b]
Length of stay (days)	4.88 (SD ± 1.68)	3.88 (SD ± 1.52)	2.97 (SD ± 1.10)	2.36 (SD ± 0.96)	<0.001[a]

[a] Kruskall-Wallis analysis of variance.
[b] Cochran-Armitage trend test.

Table 5
Intra- and postoperative complications in subsequent groups.

	Group 1 (patients 1–125)	Group 2 (patients 126-250	Group 3 (patients 251–375)	Group 4 (patients 376–500)
Intraoperative complications				
Intraoperative bleeding (blood loss of more than 300 ml)	7 (5.6%)	6 (4.8%)	6 (4.8%)	5 (4%)
Damage to the inferior vena cava	1 (0.8%)	1 (0.8%)	2 (1.6%)	–
Damage to adjacent organs (spleen, kidney, liver, diaphragm)	3 (2.4%)	1 (0.8%)	1 (0.8%)	2 (1.6%)
Postoperative complications				
Clavien-Dindo grade 1	5 (4%)	3 (2.4%)	2 (1.6%)	1 (0.8%)
Clavien-Dindo grade 2	4 (3.2%)	2 (1.6%)	–	1 (0.8%)
Clavien-Dindo grade 3	2 (1.6%)	1 (0.8%)	–	–
Clavien-Dindo grade 4	–	1 (0.8%)	2 (1.6%)	–
Clavien-Dindo grade 5	–	–	–	1 (0.8%)
Total number of patients with complications	18 (14.4%)	14 (11.2%)	10 (8%)	7 (5.6%)

The number of complications does not add up because some patients developed more than one complication.
Cochran-Armitage trend test – p = 0.013.

Table 6
Number and types of postoperative complications in the study group.

Surgical site infection	5 (1%)
Wound hematoma	3 (0.6%)
Intraperitoneal hematoma (requiring percutaneous drainage)	1 (0.2%)
Lymphorrhoea	1 (0.2%)
Hemodynamic instability (requiring ICU admission)	3 (0.6%)
Pneumonia	3 (0.6%)
Deep vein thrombosis	1 (0.2%)
Postoperative intraperitoneal bleeding (requiring relaparoscopy)	2 (0.4%)
Pleural effusion (requiring percutaneous drainage)	1 (0.2%)
Pulmonary embolism	1 (0.2%)
Respiratory failure (requiring ICU admission)	1 (0.2%)
Subarachnoid hemorrhage	1 (0.2%)
Mortality	1 (0.2%)

patients underwent surgery for isolated adrenal metastasis (mostly kidney and lung cancer). 13 (2.6%) patients were diagnosed with primary malignancy of the adrenal gland (adrenal carcinoma in 12 patients, and primary neuroectodermal tumour in 1 patient). A detailed analysis of histological types of changes is presented in Table 7.

In the group of 36 patients with malignant adrenal tumours (primary and metastatic), microscopic examination confirmed a R0 resection in 28 (77.8%) patients, and a R1 resection in 6 (16.7%). 2 patients underwent R2 resection (5.5%).

Table 7
Analysis of histological types of removed tumours.

Histological type of the tumour	n	%
Adenoma	187	37,4
Nodular hyperplasia	103	20,6
Pheochromocytoma	98	19,6
Metastasis	23	4,6
Cystis	18	3,6
Myelolipoma	18	3,6
Adrenocortical cancer	12	2,4
Oncocytic adenoma	9	1,8
Pseudocystis	8	1,6
Haemangioma	6	1,2
Ganglioneuroma	4	0,8
Adrenal gland	3	0,6
Schwannoma	3	0,6
Angiomyolipoma	3	0,6
Primitive neuroectodermal tumour	1	0,2
Neurofibroma	1	0,2
Paraganglioma	1	0,2
Accesory spleen	1	0,2
Pancreas	1	0,2
Total	**500**	**100**

5. Discussion

The analysis we have presented includes one of the largest published groups of patients with adrenal gland tumour operated in a single centre. We have been performing laparoscopic procedures of adrenal tumours as our initial method of choice for over 11 years. This paper is therefore a summary of long-term observations on the establishment and functioning of the centre for surgical treatment of adrenal pathology, deriving from a laparoscopic surgery. It was observed that, despite unchanged surgical technique, there were some changes in treatment, especially in terms of factors influencing the length of hospital stay and complications. Over the past decade, major changes occurred in the diagnosis of adrenal tumours worldwide, associated with improved access to diagnostic methods, the introduction of new methods of anaesthesia and improvements in perioperative care [9]. In general, this was reflected in the improvement in outcomes [10].

Before the era of laparoscopy, adrenalectomy was hardly ever performed in our department. The fact that we began to perform laparoscopic adrenalectomy had quickly convinced the local endocrinologists and surgeons to our unit. At the time, we were the only centre in the southern part of the country that would perform this type of procedure. Thus, in the first year of our activity, our team has already operated over 20 patients, with the numbers growing steadily to a level of 50–60 adrenalectomies annually in subsequent years.

While analysing the subsequent periods of time, we noticed the operative times were different with an unchanged mean size of the tumour. Initially, the operative time was shorter, because the operations were performed by the same experienced laparoscopic surgeon (whose overall volume was more than 250 laparoscopic adrenalectomies). Later, most of the procedures were performed by other surgeons, and recently also by residents under the supervision of experienced specialists. This resulted in a longer operative time. Presently our department hires 5 independent laparoscopic adrenal surgeons. Simply put, training has an obvious impact on our operative time. It is estimated that the learning curve of laparoscopic adrenalectomy is approximately 20–40 procedures [6–8]. Due to the profile of our department, which is one of the largest teaching units in the country (12 residencies), we do not expect the mean operative time to shorten. It should however be noted, that the results we presented for the last two groups (the time from skin incision to closure), although longer than in groups 1 and 2, are still comparable to (or slightly shorter than) those described in other studies [4,11,12]. We have further observed that operative time is significantly affected by the size of the tumour, which seems to be obvious considering the anatomical conditions and surgical technique. Importantly, this does not appear to have any effect on the clinical outcomes.

Laparoscopic adrenalectomy is considered a safe procedure, with a relatively low risk of complications (1,8–15%) and negligible mortality (below 0.5%) [4,13,14]. As in most surgical procedures, however, the safety of the operation depends mainly on the experience of the team performing the procedure. Although most procedures are now performed by trainees under supervision, the rate of perioperative complications was reduced in comparison to the first period (14.4%, 11.2%, 8%, and 5.6%, respectively). It can therefore be concluded, that the experience of the laparoscopic centre is what translates primarily into the complication rate. Similar observations are provided by the results of multicentre trials including larger groups. The authors clearly show that the complication rate and mortality is lower in high-volume hospitals (more than 40 adrenalectomies per year) [15,16]. Better results are also achieved by surgeons who operate adrenal tumours regularly [17]. Due to the large number of cases each year, we are able to offer the highest level of training to residents, providing them with continuity of practice.

In the material we presented, the total conversion rate was 1.4% and was comparable to that in other reports [4,13]. It was similar in all the analysed periods. The most common cause for conversion in our study was the oncological issue (inability of radical dissection) which differs from the reports of other authors, where the most common cause for conversion was uncontrolled bleeding [4,13]. Opinions on laparoscopic surgery for oncological indications are inconclusive. While most authors agree it is a good alternative in case of metastases, one may quite often hear an opinion that suspected adrenal cancer should be a contraindication to laparoscopy [18–21]. However, if we look at the indications for adrenalectomy due to incidentaloma, the main argument for surgery is the risk of co-occurrence of early cancer. If we strictly adhere to those criteria, we should consider open surgery in all cases (as every suspected cancer should be submitted to open surgery). Unfortunately, based on preoperative studies, we are never certain whether or not we are dealing with cancer. Of the 13 patients with primary malignant adrenal tumours, a high probability of cancer was only found among 5. In the remaining 8 patients, diagnosis was only confirmed with histopathological evaluation. In our opinion, laparoscopy is merely a method of access, and oncological results do not depend on the type of method used, but on appropriate surgical technique. The results of studies comparing laparoscopic and open procedures for cancers in other locations have shown they are comparable oncologically [22–24]. Some studies of the adrenal glands show similar results [7,25]. We believe that in most cases, a team experienced in laparoscopy and adrenal surgery is able to perform radical removal of a tumour in compliance with all the principles of oncological surgery, even in cases where a resection of adjacent organs (liver, spleen) or extended lymphadenectomy is necessary. We do not, however, support laparoscopic surgery at all costs. Conversion was necessary in 2 (8.7%) out of 23 patients with metastases to the adrenal glands and 2 (18.1%) patients with adrenal carcinoma. A minimally invasive technique allows for excellent staging, and for that reason beginning with laparoscopy seems reasonable. In the hands of an experienced surgeon, it allows for radical dissection in a similar proportion as the open access [7].

Conversion and the occurrence of intraoperative complications are associated with increased intraoperative blood loss [15,26]. In our study, the mean value was 74 ml, and there was no difference in the subsequent groups. The greatest blood loss was observed in patients with damaged large veins (inferior vena cava three times, renal vein once - sutured laparoscopically). Due to the significant intraoperative blood loss and postoperative bleeding requiring relaparoscopy, 11 (2.2%) patients required transfusion of blood products. This data is similar to the results presented in other studies [13].

Routine care after open surgery involved postoperative drainage. We have adopted this principle in the early period of laparoscopy. The analysis by Major et al. shows drainage after laparoscopic adrenalectomy is not only unnecessary, but may also be associated with an increased risk of complications [27]. Over the whole study period, we have almost entirely given up the use of drains, only leaving them in the case of increased risk of postoperative bleeding. Abandoning this procedure had a positive effect on shortening the length of hospital stay. In the first period, it amounted to nearly 5 days and was later shortened to 2.4 days. Presently, a large part of patients is discharged the next day after surgery. This is related to the established enhanced recovery after surgery protocol with clearly defined discharge criteria that allow the optimization of perioperative care, without affecting its quality. Anaesthesia involves short-acting drugs, which reduces the risk of side effects such as nausea and vomiting. Upon returning from the recovery room, patients are immediately mobilized, and full hospital diet is introduced within the first 12 h post-operation. We rely on multimodal non-opioid analgesia and local bupivacaine infiltration to trocar insertion sites. This makes next day discharge possible. We noticed the length of stay in the group 4 is shorter than in other studies, but we did not observe any serious consequences related to shorter hospital stay. According to some authors, it is completely safe for the patient [28,29].

Our study is bound by certain limitations typical for a single centre retrospective analysis. However, it is one of the largest published groups of patients undergoing laparoscopic adrenalectomy in one unit. Secondly, we have very quickly become a referral centre for adrenal pathologies, which resulted in large number of adrenalectomies performed annually. Therefore, our results cannot be directly transferred to all kinds hospitals. Another limitation is the fact that in this analysis we did not include potential postoperative complications that might have occurred later than 30 days after discharge. This could certainly influence the overall complication rate.

6. Summary

In our opinion, laparoscopic adrenalectomy, which is currently the gold standard for treatment of adrenal tumours, is a safe method associated with a low risk of perioperative complications and negligible mortality. The results of the treatment do not depend on the experience of a single surgeon, but on that of the whole team involved in perioperative care. In high volume centres with extensive experience in surgery of adrenals, this technique may provide an alternative to open surgery, also in the case of malignant tumours. However careful patient selection, along with a well trained team is critical to improve outcomes.

Ethical approval

The local independent ethics committee of the Jagiellonian University, Krakow (KBET/278/B/2012) approved the study.

Author contribution

Michał Pędziwiatr – Study conception and design, Acquisition of data, Analysis and interpretation of data, Drafting of manuscript, Critical revision of manuscript.

Mateusz Wierdak – Acquisition of data, Analysis and interpretation of data, Drafting of manuscript, Critical revision of manuscript.

Mateusz Ostachowski – Acquisition of data, Analysis and interpretation of data.

Michał Natkaniec – Acquisition of data, Analysis and

interpretation of data, Drafting of manuscript.

Magdalena Białas – Acquisition of data.

Alicja Hubalewska-Dydejczyk – Acquisition of data, Critical revision of manuscript.

Maciej Matłok – Drafting of manuscript, Critical revision of manuscript.

Piotr Major – Acquisition of data, Analysis and interpretation of data.

Piotr Budzyński – Analysis and interpretation of data, Critical revision of manuscript.

Marcin Migaczewski – Analysis and interpretation of data, Critical revision of manuscript.

Andrzej Budzyński – Study conception and design, Critical revision of manuscript.

Conflict of interest

The authors have no conflicts of interest to declare.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ijsu.2015.06.020.

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